Nov. 26, 1935. L. L. SCHAUER ET AL 2,022,436

CONVERTIBLE UPRIGHT DRILL

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Fig. 1.

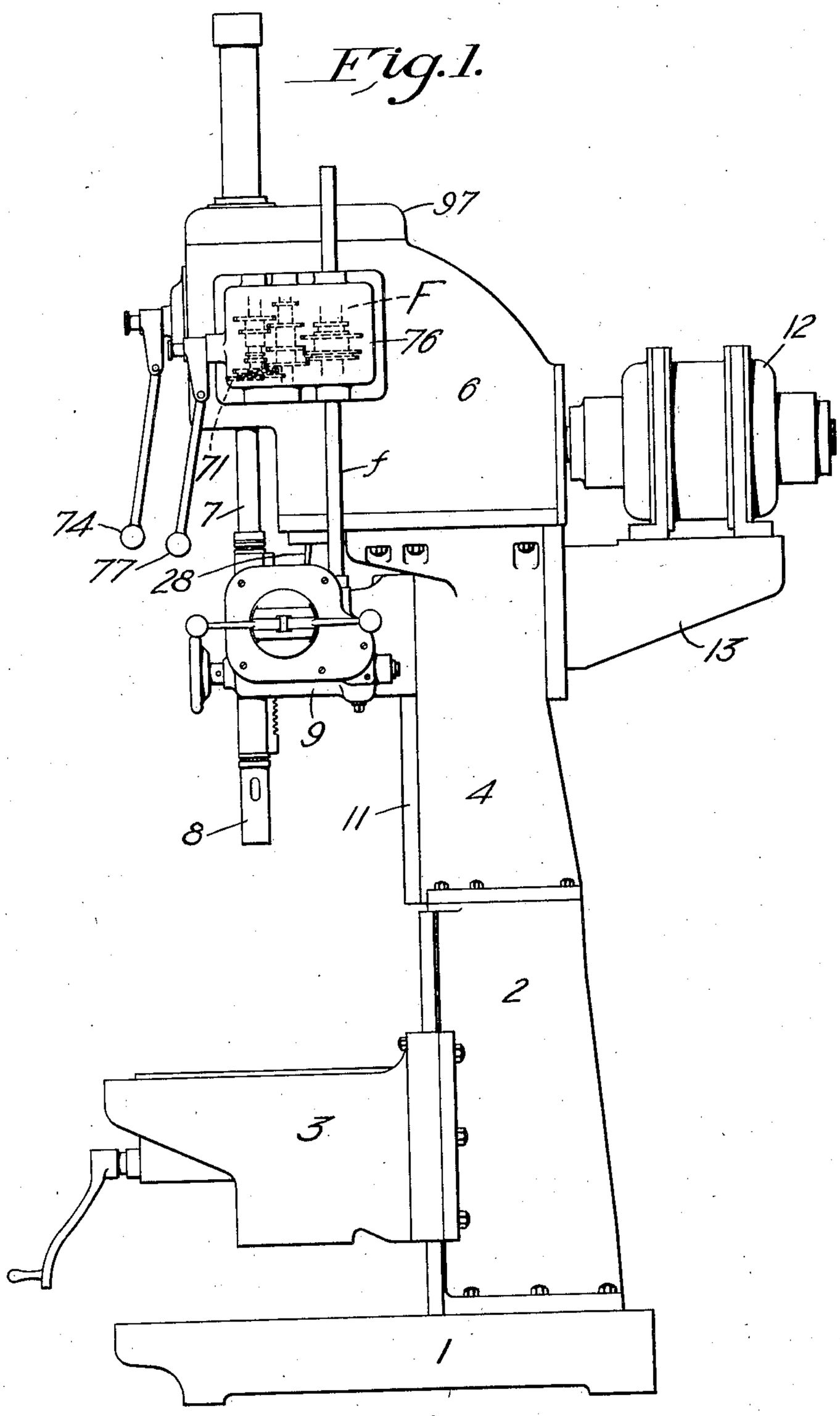

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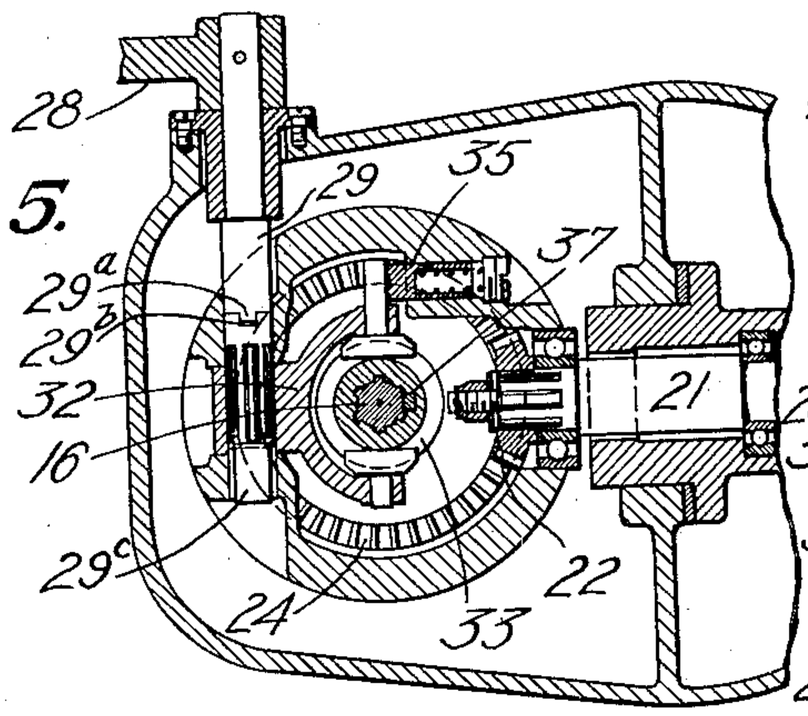
Fig. 5.



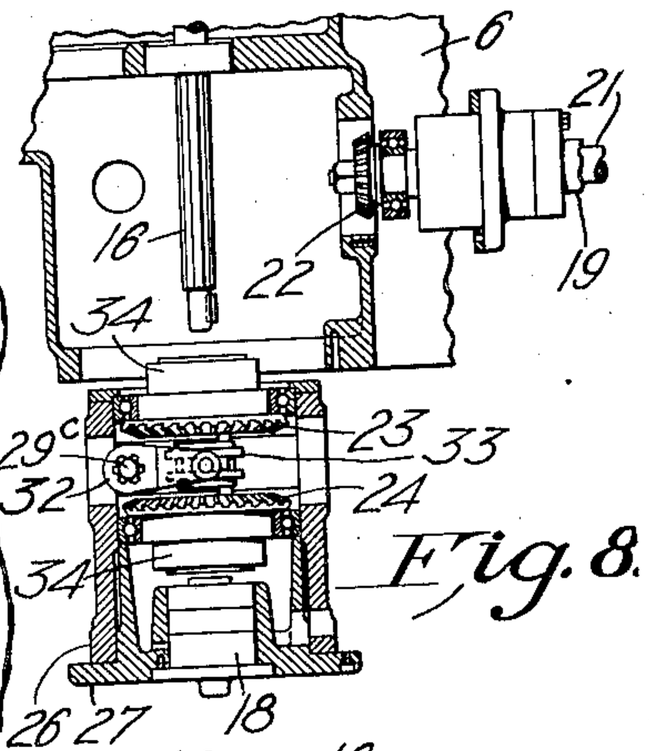


Fig. 8.

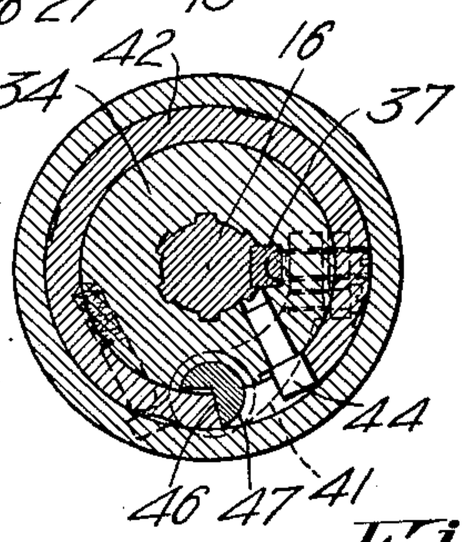


Fig. 6

Fig. 2.

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Fig. 4.

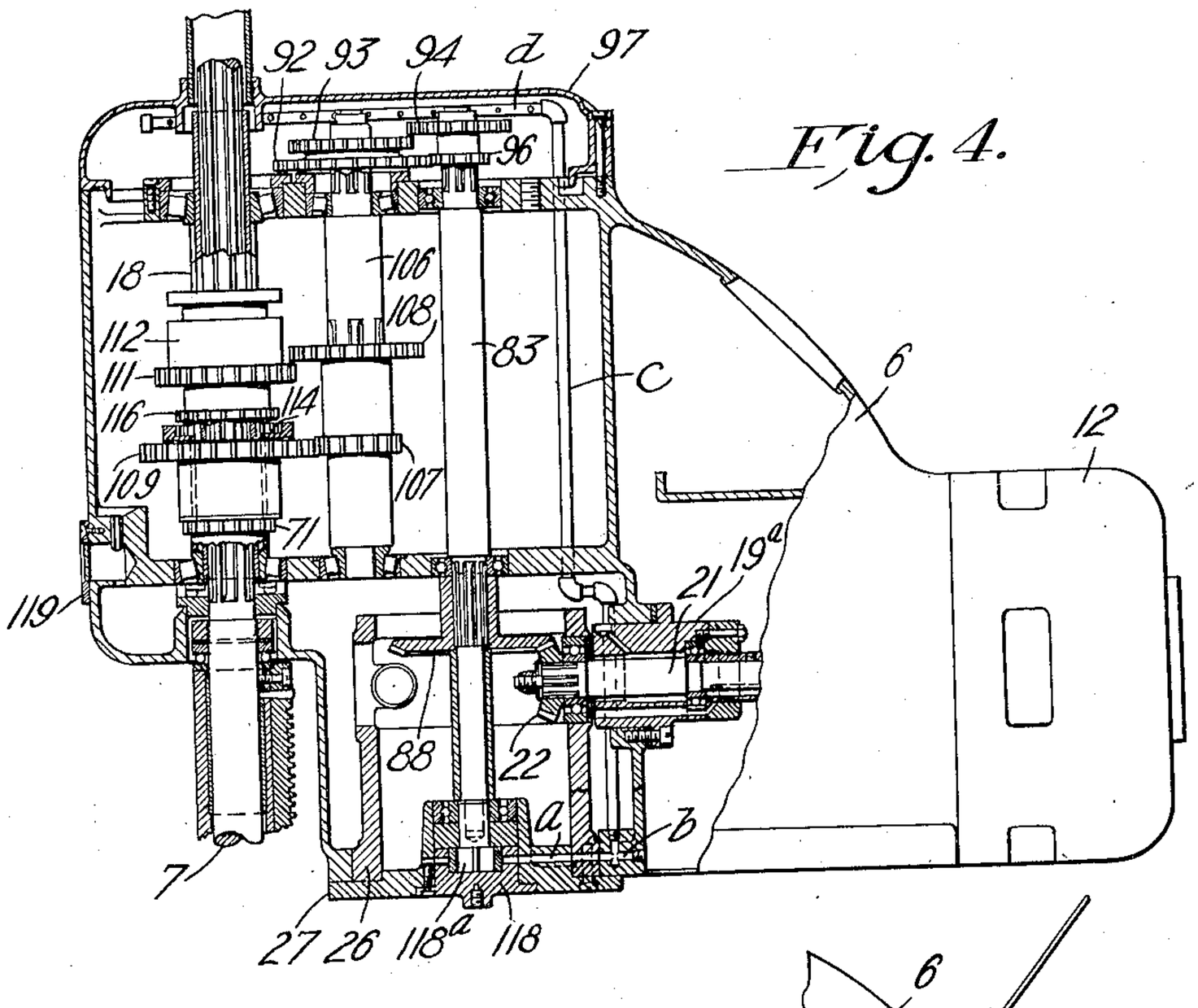

Fig. 7.

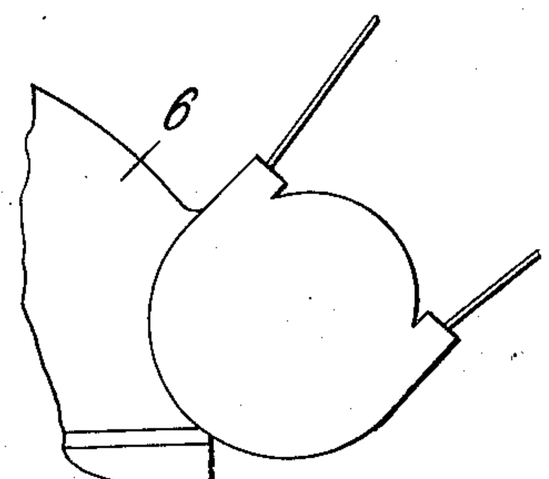

Fig. 3.

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UNITED STATES PATENT OFFICE

2,022,436

CONVERTIBLE UPRIGHT DRILL

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Application January 8, 1932, Serial No. 585,478

6 Claims. (Cl. 77—5)

This invention relates to machine tools and is more particularly concerned with reversers and change speed driving mechanisms for the spindle or spindles of drilling machines.

Modern manufacturing methods have tended to standardize production and, in the interests of economy, high production plants demand single purpose machines devoid of complicated adjustments. However, efficiency likewise requires manufacturers to use multiple purpose machines capable of desired adaptations to suit various manufacturing operations.

This invention has for its primary object to provide a drilling machine adaptable to be alternatively fitted with separate and interchangeable power transmission mechanisms, each designed to impart different combinations of rates of rotary and axial movements to the tool spindle connected therewith, whereby the one machine may be initially assembled or subsequently easily and readily converted from a single purpose machine to a multi-purpose machine, or conversely.

Another object of this invention is to provide a standard head-bracket or gear-box adapted to receive one of a plurality of interchangeable power transmission mechanisms, in such a manner that one or more shafts, gears, etc., may be easily removed or replaced without dismantling the entire machine in order that the user may have available a total of four, eight or twelve selective speed and feed combinations for effecting given tooling operations on a particular class or character of work pieces.

Still a further object of this invention is to provide a reversing mechanism insertable in the head-bracket as a complete, self-contained removable unit, adapted to transmit motion to the tool spindle in either forward or reverse directions and irrespective of the direction of movement of the prime mover. And as a further refinement to arrange the reversing mechanism in such a position with respect to the remainder of the transmission mechanisms that the reverser will be driven at a constant speed, under all conditions, thereby to insure maximum efficiency and power at all spindle speeds.

Another object of this invention is to provide means whereby a single head-bracket may be adaptable for either a belt drive or a plurality of motor mountings, each of which has its own characteristic advantages, under various conditions of operation.

To attain the objects of this invention it is proposed to construct the frame or column of a drilling machine with a readily removable head-bracket adapted to be fitted with one of a plurality of power transmission gear trains, each train being adapted to be installed or substituted in place of some other train for driving the spindle at a selected number of rates.

A self-contained reversing mechanism providing means for instantly reversing the direction of rotation of the spindle without undue jarring or stressing of the shafts and gearing is provided and housed within a drum or housing likewise removably mounted as a unit in the standard head-bracket. A hand control member located within convenient reach of the operator is adapted to effect the reversing operation, and also to position the parts in an intermediate or neutral position whereby the tool spindle and gear trains may remain stationary although the power shaft or prime mover may be in motion.

The housing is also designed as to permit the use of individual electric motors, in place of a belt and pulley drive. For example, the head-bracket is constructed to enable any one of three conventional types of motors to be used, namely, the "can" or "shell-type", adapted to conserve space by having it partly insertable within the machine and fitted to the drive shaft by a close coupling designed to insure rigidity; or a standard "foot-type" motor may be used, adapted to be mounted entirely exteriorly of the housing upon a bracket or support, and designed to be easily accessible; or a "flange-type" motor that may be bolted directly to the machine adjacent the head gearing.

The moving parts of any one of the power transmissions are adequately lubricated at all times by means of a cascade lubricating system incorporated within the head-bracket and arranged to force a generous supply of lubricating material to the uppermost portions of the head-bracket where it cascades downwardly over the transmission mechanisms. Due to the particular arrangement and operation of a vane-type pump located in a well formed at the base of the head-bracket and driven at a constant speed, the head gearing receives an ample supply of lubricant whenever the spindle is in motion, irrespective of its direction of rotation.

A particularly advantageous feature of this invention, especially in view of the constant speed powerful and quick acting reversing mechanism, is that the drilling machine constructed in the manner hereinafter set forth in detail is adaptable not only for drilling, tapping and facing

operations but for many other related or analogous uses as well.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Figure 1 is a side elevation of an upright drilling machine embodying the present invention. Fig. 2 is an enlarged sectional view of the head-bracket the gearing for a multiple purpose machine journaled therein. Fig. 3 shows a similar view of the head-bracket but illustrating the head fitted with a gear transmission assembly for a single purpose machine and illustrating also the can-type motor mounting. Fig. 4 is a view similar to Figs. 2 and 3, except that a third and more simpler form of gear train has been illustrated in conjunction with the flange type of motor mounting. Fig. 5 is a sectional plan view substantially along the line **5—5**, Fig. 2 illustrating the hand lever control for the clutch reversing mechanism. Fig. 6 is a sectional view of one of the clutches in the reversing mechanism. Fig. 7 is a detail view of a belt drive arrangement that may be resorted to in place of individual motors. Fig. 8 is a detail view of a portion of the head-bracket illustrating the unitary reversing mechanism removed from the casing.

Referring to the drawings, Fig. 1 represents one form of a machine tool to which this invention is particularly adaptable, namely, an upright drilling machine which is provided with a base **1**, a frame or column **2** that supports a vertically adjustable work-table **3**. An off-set raising block **4** is mounted upon the column **2** and is provided with guideways **11** upon which is translatably mounted the drill head **9** that journals the drill spindle **8**. The upper portion of the spindle is journaled in a head-bracket **6**, also supported by the block **4**, and maintains the spindle shaft **7** in vertical alignment. Power for effecting movements of the spindle may be provided by a motor **12** which in this instance is mounted on a suitable bracket **13** supported by the column **4**, or, if desired, may be derived from a line shaft and brought into the machine by way of the pulley and belt drive arrangement illustrated in Fig. 7.

Referring more particularly to Fig. 2, a multiple purpose machine is provided by incorporating in the standard headbracket **6** the power transmission assembly shown in this figure. With this arrangement the power from the motor **12** is transmitted to the spindle shaft **7** through the unitary reversing mechanism **14**, or a one way driving connection such as illustrated in Fig. 3, and thence through transmission gear and clutch units located upon shafts **16** and **17**, to the sleeve member **18** splined to the spindle shaft **7**.

The power connection with the reversing mechanism **14** is effected through a suitable coupling **19** keyed to the motor shaft **20** and also to the power shaft **21**. Secured to the inner end of the shaft **21** is a bevel gear **22** that meshes with two bevel gears **23** and **24** journaled in bearings provided by a drum or housing **26**. The housing **26** is removably mounted as a unit within the head-bracket **6** and suitable screws **27a** are provided to maintain the cup member **27** and casing **26** securely in place within the housing.

The gears **23** and **24** are driven in opposite directions, and either may be clutched to the shaft **16** to cause the latter to rotate in a given direction. To effect engagement of one of the clutches a direction control lever **28** is provided which is secured to one end of a clutch spool shifting shaft **29**. The inner end of the shaft **29** has a rib and groove connection **29a—29b** with a short shaft **29c** upon which is splined or keyed a shifting fork **32** for controlling the position of a clutch spool **33**. The spool **33** has secured thereto a cam bar **37** which is provided at its ends with an inclined face **38** adapted to engage the free ends of clutch levers **41** and **41a** selectively to rock same about their fulcrums **47** (Fig. 6) thereby to render one of the clutches effective.

In order that the reversing mechanism be removable it is essential that there be but a few parts designed and arranged as compactly as possible. To accomplish this end without sacrificing strength or rigidity of the mechanism, it is proposed to mount the oppositely running gears **23** and **24** in relatively large anti-friction bearings and proportion the parts so that the resultant line of force of the driving gear falls within to a circle not larger than the pitch circle or the circle formed by the path of the running balls in the anti-friction bearings, and to arrange the clutches later to be described in detail, substantially in the same plane as the bearings. In this way a strong durable easily removable reversing unit is constructed and one in which only two bearings need be employed, one for each gear, and the customary sleeve on which the gears of reversing mechanisms, heretofore designed, are mounted, may be eliminated.

Referring more particularly to Fig. 2, it will be noted, that each of the bevel gears **23** and **24** are provided with extended hub portions and are journaled in the large anti-friction bearings mounted in the drum **26**. The inner surface of the hubs are mounted upon sleeve members **34** that are rotatable with but have a splined connection with the removable shaft **16**. So that either of the gears **23** or **24** may transmit motion to the shaft **16**, each is provided with a relatively wide inner surface adapted to be engaged by wide expanding rings **42** carried by the sleeve members **34** and located substantially in the same plane as the anti-friction bearings above mentioned.

Referring to Fig. 6, it will be noted, that one end of the expansible ring **42** abuts against a stop pin **44** carried by the sleeve member **34**, and the other end of the ring engages a notch **46** formed in a rock shaft **47**. Thus as the shaft **47** is oscillated by the rocking of clutch lever **41**, the ring **42** is expanded and brought into driving engagement with the hub of the running gear **23** thereby transmitting the rotary motion of the gear to the shaft **16**. Spring pressed detent means such as that shown at **35** (Fig. 5) may be provided for retaining the clutch shifting fork **32** in any one of its three positions. At the free ends of the levers **41** and **41a** adjusting screws **39** and **39a** are provided for taking up wear and for varying the degree of frictional engagement between the members.

Loosely mounted upon the shaft 16 is a gear element 50, one portion of which is provided with gear teeth 51 and another portion thereof provided with internal clutch teeth 52. Also carried by the shaft 16 but splined thereto is a three part unit 54 providing gears 55 and 56 and clutch teeth 53. The teeth 53 are adapted to be engaged with the clutch teeth 52 of the unit 50 and when thus engaged, rotary motion of the shaft 16 is transmitted to the gear 51 and thence to the shaft 17 through the gear 59. When the clutch gear unit 54 is moved upwardly one position the clutch teeth 52—53 are disengaged and gear 53 meshes with the gear 61 whereby shaft 17 is driven at an increased rate of speed. Further movement of the unit 54 upwardly, engages gears 55 and 57, and shaft 17 is driven at a still faster rate of speed. A further increase may be obtained by shifting the unit 54 still further and thus bring the gear 56 in mesh with the gear 58. The four speeds of the shaft 17 are again multiplied by three, in a manner shortly to be explained, making a total of twelve speeds to the spindle.

The upper spindle shaft is incased in and splined to a non-translatable but rotatable sleeve 18 journaled in bearings provided by the housing 6, so as to be translatable therein toward or away from the work-piece. The outer surface of the sleeve is also provided with splines and has mounted thereon a sliding gear unit 65, a loose gear unit 67 and a fixed gear unit 71. The latter gear unit is the point of power take-off for the feed gear as will hereinafter appear.

The gear element 68, it will be noted, is constantly in mesh with gear 69 on shaft 17 and when the clutch gear element 65 is lowered its full distance clutch teeth 66 and 66a are brought into engagement and power received from the shaft 17 is thus transmitted to the spindle. At the extreme upward position of the unit 65, gears 62 and 63 transmit rotary movements to the spindle at a faster rate, and if the unit is in its intermediate position, gears 58 and 64 transmit motion at an intermediate rate. The three additional speed changes just mentioned are located, it will be observed, adjacent the spindle and provide the course changes in spindle speeds, the finer speed changes being effected closer to the source of power so as to relieve the larger portion of the mechanism from the shocks occasioned when effecting major changes in the rate of speed. Suitable shifting forks (not shown) are provided which engage the units 54 and 65 in the usual way and which are operated by a single hand control lever 74. This one hand lever, by means of suitable connections with the shifting forks may be placed in any one of four angular positions in each of three different planes transversely arranged and thus effects the desired shifting of the gear and clutch members to provide twelve different speeds to the spindle shaft 7. However, in the interests of clarity the connections between lever 74 and the gear units have been omitted.

A change speed power feeding means is provided by a series of gear trains, indicated generally at F, which are assembled within a bracket 76 removably secured to the head-bracket 6, and which transmit power from the spindle sleeve 18 to the feed shaft *f* and thence to the drill head 6 and spindle 8 in the usual way. A control lever 77, Fig. 1, operable in a manner similar to the lever 74, is conveniently arranged and enables the operator to effect a selected feed rate within the range of the machine.

The foregoing description taken in connection with the drawings illustrate one arrangement of the gears and shafts for effecting a great many speeds and feeds should the user desire such a wide range. However, numerous occasions arise wherein a user will require a fewer number of speeds or feeds and with that end in view this invention proposes a construction whereby a standard form of tool head 6 may be easily and readily adapted to meet such other conditions.

If the character of the tooling operations does not require the reversing mechanism heretofore explained, the same may be removed as a unitary structure and another unit inserted in place thereof. To make the change-over the motor and shaft 20 are withdrawn and journal bearing 19a unbolted from the frame thus permitting the shaft 21 and bevel gear 22 to be withdrawn from the housing 26. The clutch shifting shaft 29 is then removed and the housing 26 and mechanism contained therein, upon the release of screws 27a, is free to be removed from the head casting 6 in its assembled form. Fig. 8 illustrates in a general way the removable-as-a-unit feature just explained. A different unit such as illustrated in Figs. 3 and 4 may then be inserted and the gear 22 replaced and connected with the driving motor in the same manner as heretofore described.

So likewise may other shafts and gear combinations be inserted in the head in place of the more complex arrangement above explained. Fig. 3 illustrates a simplified construction in which the standard head-bracket 6, the motor 12, the power or driving shaft 21, and the bevel gear 22 are identical with the construction above described with reference to Fig. 2. However in the simplified transmission shafts 83 and 84 are journaled in bearings in the housing, and transmit rotary movements to the spindle drive sleeve 18 and the spindle shaft 7 at various other rates, as will later be apparent. The motion of gear 22 is transmitted to a bevel gear 88, splined to the shaft 83, thence to shaft 84 through reversible and transposable pick-off gears mounted at the top thereof and finally to the spindle sleeve through gears 89 and 91.

The pick-off gear units comprise gears 92 and 93 and gears 94 and 96, the two units being designed so as to be interchangeably and invertably mounted upon the shafts 83 and 84, thereby to transmit one of four speeds selectively to the spindle shaft 7. Thus in the position shown a slow speed of the spindle is effected but if the both units are inverted a slightly increased speed results; if the gears are transposed a still faster speed is effected; and if the gears are again inverted while transposed a fourth spindle speed may be had.

To exclude dirt or other foreign material and to prevent the splashing of lubricant, a removable cap or cover member 97 is bolted to the head-bracket and is preferably made of aluminum or other light weight metal to facilitate easy removal. It will be seen that this simplified power transmission necessitates but three actual tooth contacts to produce any one of four speeds. A gear 71 is also fixed to the sleeve 18 to provide a driving connection to the spindle feed gears as heretofore explained.

A third form of power transmission assembly is shown in Fig. 4 and provides means for selectively effecting any one of eight individual speeds

to the tool spindle with but the addition of two gears and one clutch. This alternative construction, although it admits of eight different speeds, is arranged so that two of them may be quickly changed by means of a hand control lever similar to the lever 74. This secondary change speed set comprises gears 107 and 108 which are fixed upon the shaft 106 and adapted respectively to engage gears 109 and 111, the latter being integral with a clutch element 116 and splined to the spindle sleeve 18. A gear 109 is loosely mounted on the sleeve and is also provided with clutch elements 114 adapted to engage the complemental clutch member 116 of the unit 112. Thus it will be seen that sliding of the gear unit 112 downwardly engages the clutch teeth 114—116 and a relatively slow movement is imparted to the spindle, while a movement of the unit 112 upwardly engages gears 108 and 111 and relatively rapid movements may be imparted to the spindle depending upon the positioning of the pick-off gears 92, 93, 94 and 96.

All of the moving parts in the head-bracket, whether the bracket is initially fitted with gearing designed to effect 4, 8, or 12 selective spindle speeds with or without the unitary reversing mechanism are maintained adequately lubricated by means of a cascade lubricating system carried wholly within the head-bracket.

To this end, a pump 118 carried preferably in the removable unit and driven at a constant speed irrespective of the spindle speed, is maintained submerged in the lubricant reservoir located in the base of the head-bracket, and comprises a rotor 118ª adapted to be driven by either of the shafts 16 or 83. The rotor is mounted within a casing 118 which provides intake and discharge ports for the fluid. The discharge port *a* passes through members 26 and 27 and communicates with a port *b* provided by the head 6 (see Fig. 4) and thence with a vertically arranged pipe conduit *c*. Lubricating fluid discharged by the pump forced upwardly through pipe line *c* to a perforated pipe *d* which extends horizontally beneath the cap member 97 where it is discharged over the uppermost moving parts. The lubricant then cascades downwardly over the entire transmission and finally returns to the reservoir for recirculation. Suitable passageways are provided at the various bearings to permit the lubricating fluid to reach all of the moving parts. To assist the operator, in determining whether the oiling system is properly functioning, a telltale drip indicator 119 is provided at the front of the machine whereby he may readily note whether or not lubricating oil is being supplied to the running parts.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims:—

Having thus revealed this invention, we claim as new and desire to secure the following combinations and elements, or equivalents thereof, by Letters Patent of the United States:—

1. A convertible upright drilling machine combining a housing member; a spindle rotatably mounted therein; a multi-speed spindle driving transmission for imparting one of a predetermined range of speeds to said spindle and arranged as to be removable from said housing and replaced by another transmission adapted to effect a range of spindle speeds different from the speeds of said first mentioned transmission; said housing member also being provided with a well portion; a sleeve member insertable as a unit in said well portion and adapted to be fitted with means for reversing the direction of movement of said spindle or with means for effecting unidirectional movements to said spindle; and a power input shaft detachably connected with said insertable unit.

2. A machine tool combining a housing member; a spindle rotatably mounted therein; a multi-speed driving transmission for effecting one of a predetermined range of speeds of rotation to said spindle and arranged as to be removable from said housing and replaced by another transmission adapted to effect a range of spindle speeds different from the range of speeds of said first mentioned transmission; said housing member also being provided with a well portion; a sleeve member insertable as a unit in said well portion; means carried by said insertable member for reversing the direction of rotary movement of said spindle; and a power input shaft detachably connected with said reversing means.

3. A transmission mechanism for a drilling machine combining a housing element; a plurality of shafts removably journaled in said housing; a plurality of sets of gear trains for transmitting rotary motion from one of said shafts to another at any one of a plurality of selectively available speeds; a unitarily constructed reversing means removably mounted in said housing and associated with said transmission mechanism for changing the direction of operation thereof; and a prime mover removably fitted to said housing element and having a separable driving connection with said reversing means to permit the removal of said reversing means as a unitary assembly.

4. An upright drilling machine combining a housing member; a spindle rotatably mounted therein; a multi-speed driving transmission for effecting a predetermined range of electively available speeds to said spindle journaled in said housing; said housing member also being provided with a well portion; spindle reversing means insertable as a unit in said well portion; and a power input shaft removably connected with said insertable unit and capable of being detached and withdrawn from the well portion and from the reversing unit to permit the removal of said insertable unit.

5. A drilling machine combining a gear housing; a tool spindle; driving means for said spindle including change speed transmission mechanisms removably mounted in said housing, said driving means also including a drive shaft and a reversing mechanism for changing the direction of movement of said spindle, said reversing mechanism being journaled in a separate casing and removable from said housing as a unit; and a lubricating system for said transmission comprising a pump mechanism carried by said casing and a series of intercommunicating aligned sets of fluid channels between said pump, casing and housing, said pump mechanism having a detachable connection with said driving means so as to be removable from said housing unitarily with said removable reversing unit or from said casing separately.

6. A convertible upright drilling machine combining a housing member; a spindle rotatably mounted therein; a variable speed driving transmission for imparting various rates of movement to said spindle selectively and arranged as to be removable from said housing and replaced by another transmission having a range of elective spindle speeds different from said first mentioned variable speed spindle driving transmission; said housing member also being provided with a well portion; a sleeve member insertable as a unit in said well portion and adapted to be fitted electively with means for reversing the direction of movement of said spindle or with means for effecting uni-directional movements to said spindle; a power input shaft insertable in said well and detachably connected with said insertable unit said shaft being removable from the well to permit the removal of said sleeve member and parts carried thereby; and means removable with said insertable unit and common to all of said driving transmissions for supplying lubricating material to the mechanisms in said housing.

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